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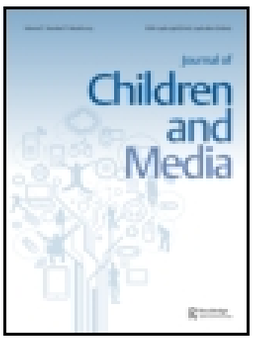

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Investigating the association between children's screen media exposure and vocabulary size in the UK

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ABSTRACT

Children are growing up in a digital age with increasing exposure to television and touchscreen devices. We tested whether exposure to screen media is associated with children's early language development. One hundred and thirty-one highly educated caregivers of UK children aged 6–36 months completed a media exposure questionnaire and vocabulary measure. 99% of children were read to daily, 82% watched television, and 49% used mobile touchscreen devices daily. Regression analyses revealed that time spent reading positively predicted vocabulary comprehension and production scores at 6–18 months, but time spent engaging with television or mobile touchscreen devices was not associated with vocabulary scores. Critically, correlations revealed that time spent reading or engaging with other non-screen activities was not offset by time spent engaging with television or mobile touchscreen devices. Thus, there was no evidence to suggest that screen media exposure adversely influenced vocabulary size in our sample of highly educated families with moderate media use.

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Children grow up surrounded by media including books, television, and more recently, mobile touchscreen devices. In a 2013 survey, television was the most popular medium with 31% of 0–2-year-old and 67% of 2–4-year-old American children watching television at least once a day for a total 44 and 64 min a day, respectively (Rideout, 2013). However, mobile touchscreen use among children appears to be increasing. In 2013 in the US, 6% of children under the age of 2 years were using mobile touchscreen devices, for 2 min per day on average (Rideout, 2013). In 2015 in France, 21% of children under the age of 2 years were using mobile touchscreen devices (Cristia & Seidl, 2015). On top of screen media exposure, children in the US under the age of 2 years also spend on average 19 min per day reading, and children aged 2–4 years spend around 29 min reading per day (Rideout, 2013).

Time spent engaging with screen media impacts parent–child interactions. There is some evidence that screen time displaces time spent interacting with parents or doing other activities between 0 and 2 years of age (Vandewater, Bickham, & Lee, 2006). Specifically, Vandewater et al. (2006) found that children interacted with parents 52 mins less for each hour of time spent

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watching television. Nevertheless, the authors found no relationship between time spent watching television and time spent reading. Other research has found that when television is on in the background, the quality and quantity of parents' speech decreases (Christakis et al., 2009; Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009; Pempek, Kirkorian, & Anderson, 2014). In addition, observational data demonstrate that parents' mobile touchscreen device use can reduce parent's attention and engagement with their child (Radesky, Silverstein, Zuckerman, & Christakis, 2014). Given that children's language development is strongly correlated to the number of words that children hear on a daily basis (Hart & Risly, 1995; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Weisleder & Fernald, 2013), there is some concern as to the implications of screen media exposure on children's language development.

These concerns do not extend to children's exposure to books. Reading typically elicits speech input from parents (Nyhout & O'Neill, 2014) and a number of studies have demonstrated a clear link between children's storybook reading and language development (Elley, 1989; Farrant & Zubrick, 2012; Ninio, 1983; Raikes, Pan, Luze, Tamis-LeMonda, & Brooks-Gunn, 2006; Scarborough & Dobrich, 1994; Sénéchal, LeFevre, Hudson, & Lawson, 1996; Sénéchal & LeFevre, 2002). Indeed, storybook reading is a significant predictor of children's vocabulary comprehension and production under the age of 2 years (Robb, Richert, & Wartella, 2009; Zimmerman, Christakis, & Meltzoff, 2007).

The impact of time spent watching television on children's language development is less clear-cut. A longitudinal study based on parental report following infants from 6 to 30 months found that some children's television programs, for example *Dora the Explorer,* were associated with higher vocabulary and expressive language scores than others such as *Teletubbies* (Linebarger & Walker, 2005). Indeed, further work has reported a negative association between baby DVDs and children's vocabulary size, with children who were regularly using such media understanding 6–8 words less at 8–16 months, while reading and storytelling once a day was associated with gains in vocabulary (Zimmerman et al., 2007 also see Chonchaiya & Pruksananonda, 2008). Although, reanalysis of Zimmerman et al's findings found a null/minor positive relationship between baby media and receptive language at 6 to 16 months of age (Ferguson & Donnellan, 2014). Moreover, further work has found no relationship between television viewing at 6, 12, and 24 months and language development at 3 years of age (Schmidt, Rich, Rifas-Shiman, Oken, & Taveras, 2009).

When television exposure is manipulated experimentally, research has reported that for infants aged 8–15 months parental report shows an increase in the number of DVD specific words that children understand following exposure to a DVD for 4 weeks (Vandewater, 2011). However, while Richert, Robb, Fender, and Wartella (2010) found a positive association between parental reports of the number of DVD specific words that children understand and DVD exposure, they found no relationship between DVD exposure and children's recognition of DVD specific words when word learning was tested experimentally (also see DeLoache et al., 2010; Robb et al., 2009). To our knowledge, no studies to date have considered the relationship between children's language development and mobile touchscreen device use. Taken together, it therefore remains to be determined whether screen media can influence children's language development.

To date, the majority of studies on children's media exposure (e.g., Rideout, 2013; Rideout, Vandewater, & Wartella, 2003) and its role on language development (e.g., Vandewater, 2011; Zimmerman et al., 2007) have been conducted in the US. Cultural differences between the US and the UK may influence children's exposure to media. For example, while the American

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Academy of Pediatrics (2016) provide clear recommendations for limiting screen media use by young children, no such guidelines are offered in the United Kingdom. Moreover, due to children's increasing access to mobile touchscreen devices (Cristia & Seidl, 2015), it is important that research starts to consider the role that mobile touchscreen devices have, if any, on children's language development. The purpose of the present study was to consider whether children's media exposure (storybooks, TV, and mobile touchscreen devices) is associated with children's language development at 6–36 months in a UK-based sample. It is important to note that one limitation of the study is our predominantly highly educated sample. However, given that children's language development is strongly influenced by parental education and socioeconomic status (SES; e.g., Hart & Risly, 1995; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010; Weisleder & Fernald, 2013), this homogeneous sample helps to controls for these factors.

An online questionnaire was constructed to measure children's media exposure and language development. Vocabulary scores were determined using two British adaptations of the Communicative Development Inventory (CDI): the UK-CDI for the 6–18-month-old infants and the Lincoln UK-CDI for the 19–36 month olds (Alcock, Meints, Rowland, Christopher, Just, & Brelsford, in prep; Meints & Fletcher, 2001). The CDIs have high validity with other measures of children's vocabulary development and have been widely used to address questions about language development (see Law & Roy, 2008 for review).

Hypothesis 1: Language development will be negatively related to television exposure but positively related to storybook reading. (Robb et al., 2009; Zimmerman et al., 2007)

Hypothesis 2: Mobile touchscreen device use will be negatively associated with children's language development due to the sheer variety of apps that do and do not meet criteria for facilitating children's learning. (Hirsh-Pasek et al., 2015)

Method

Participants

A total of 131 participants from the UK completed the media exposure questionnaire, and 97 participants then went on to complete one of the CDI questionnaires (UK-CDI $n = 54$; Lincoln UK-CDI Toddler $n = 43$). An additional 56 participants took part in the questionnaire but were excluded because they omitted more than 20% of the questions for the media exposure questionnaire. This criterion was selected in order to filter out those participants that had failed to finish the questionnaire or had skipped large portions.

To be eligible for the study, parents had to live in the United Kingdom with a child aged between 6 and 36 months. After reading information about the study, parents ticked a box to give their consent to participate in the questionnaire. Ethical approval for the study was obtained from the Lancaster University Research Ethics Committee.

Procedure

The data were collected via an online questionnaire between 28 April 2015 and 26 June 2015. The questionnaire was advertised online via newsletters, websites, and social media targeting a highly educated sample. Parents who gave their consent to participate in the

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study first took part in a media exposure questionnaire followed by the CDI appropriate for the child's age group.

Materials

Media exposure questionnaire

The media exposure questionnaire included a demographic subsection containing questions about parents' age, education, and time spent with their child on a typical workday and weekend and a media subsection. In the media subsection questions included "Which of the following if any, do you have in your home? TV, cable/satellite, video game player that hooks up to your TV, DVD player hooked up to your TV, portable DVD player, handheld video game player (e.g., PSP, Ninetendo DS), smart phone, tablet device (e.g., iPad), e-reader (e.g., Kindle), laptop/desktop computer, internet access", "On a typical day, how much time, if any, does your child spend: watching TV, using a mobile touchscreen device (tablet/smart phone), reading/read to" (responses: 0, 5, 15, 30, 45 min, 1, 1 ½, 2, 2 ½, 3+ h), "When someone is at home in your household, how often is the TV on, even if no one is actually watching it?" (responses: always, most of the time, half of the time, less than half of the time, hardly ever, never, no TV in house) and "On a typical day, how much time do you spend with your child doing 'activities' (e.g., cooking, baking, playing, riding bikes, doing arts and crafts, dancing, going to the park, playing sports, visiting the library). Do not count time spent reading or using media together (e.g., video games, TV, DVDs, apps)" (responses: 0, 5, 15, 30, 45 min, 1, 1½, 2, 2½, 3+ h). We chose to measure media exposure on a "typical day" rather than "yesterday" to avoid capturing a particularly low or high media exposure day compared to children's typical exposure (see Vandewater & Lee, 2009 for a discussion on measuring children's media use). We also included questions about content, "Please list the names of the TV shows/apps/storybooks that your child typically watches/uses/reads" to determine whether children were exposed to child-directed or adult-directed television programs and to assess activities included in children's app use (also see Barr, Danziger, Hilliard, Andolina, & Ruskis, 2010; Mendelsohn et al., 2010; Tomopoulos et al., 2010).

CDIs

Parents of children aged 6–18 months filled out the UK-CDI (392 words; Alcock et al., in prep) and parents of children aged 19–36 months filled out the Lincoln UK-CDI Toddlers (663 words; Meints & Fletcher, 2001). These questionnaires offer a checklist of words from a number of different categories (e.g., animals, household items, food and drink). Parents are asked to indicate whether their child understands or understands and says each word.

Results

Participant demographics

Parent

The majority of parents answering the questionnaire were British, aged 25–34 and educated to degree level or higher (see Table 1). In all instances, the child lived full time with the parent answering the questionnaire.

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Table 1. Demographics %(*n*) of the final sample.

		Mother	Father	Child
Ethnicity	White British	86.3% (113)	87.0% (114)	83.2% (109)
	Asian British	1.5% (2)	.8% (1)	1.5% (2)
	Black British		.8% (1)	
	White Other	9.9% (13)	4.6% (6)	3.8% (5)
	Asian Other	1.5% (2)	.8% (1)	
	Black Other		.8% (1)	
	Mixed	.8% (1)		3.8% (5)
	Other		1.5% (2)	.8% (1)
	Not reported		3.8% (5)	6.9% (9)
Age	Under 25	1.5% (2)		
	25–34	62.6% (82)		
	35–44	35.1% (46)		
	45+	.8% (1)		
Highest level of education	Degree/higher	81.7% (107)		
	Below graduate	12.2% (16)		
	Vocational	6.1% (8)		
UK residence	England	95.4% (125)		
	Scotland	3.1% (4)		
	Wales	1.5% (2)		

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Child

Children were aged 6–36 months (*m* = 20 months, SD = 8.33; Gender: Male = 61, Female = 70) and primarily British (see Table 1). The majority of children were either the only child in the family (*n* = 76) or the youngest child (*n* = 43; middle child *n* = 2, oldest child *n* = 10).

Media exposure

The majority of parents spent all day with their child (*n* = 75, morning *n* = 8, afternoon *n* = 5, evening *n* = 40, not reported *n* = 3). On average parents reported spending around 156 min (SD = 42.1) a day doing non-media-related activities such as cooking, baking, playing, riding bikes, doing arts and crafts, dancing, going to the park, playing sports, or visiting the library.

All parents had at least two types of screen media available in their home; 98.5% (*n* = 129) had a smartphone, 96.2% (*n* = 126) a laptop/desktop computer, 94.7% (*n* = 124) a TV, 87% (*n* = 114) a touchscreen tablet, 75.6% (*n* = 99) a DVD player, 50.4% (*n* = 66) a video game player, and 41.2% (*n* = 54) had an e-reader in their home. Overall, 98.5% of children were read to daily (6–18 month olds *n* = 59, 19–36 month olds *n* = 70), 81.7% of children watched TV daily (6–18 month olds *n* = 47, 19–36 month olds *n* = 60), and 48.9% of children used mobile touchscreen devices daily (6–18 month olds *n* = 18, 19–36 month olds *n* = 46). Of the children that were exposed to each type of media, the mean time spent reading, watching TV or using mobile touchscreen devices is reported in Figure 1.

Parents reported a number of activities that their children do when using mobile devices including using apps (*n* = 52), YouTube (*n* = 10), FaceTime (*n* = 7), looking at photos (*n* = 6), and watching TV (*n* = 3). All of these activities were coded as mobile device time throughout the analyses. Parents also primarily reported that their children were watching children's programs when watching the TV (*n* = 102; adult programs *n* = 3, both children's and adult programs *n* = 2). Background television was defined as times when the television was on when no one was watching it. Just 19 families never had the television on in the background, while the remaining 112 families had the television on in the background always (*n* = 5), most of the time (*n* = 22), half of the time (*n* = 20), less than half of the time (*n* = 32), and hardly ever (*n* = 33).

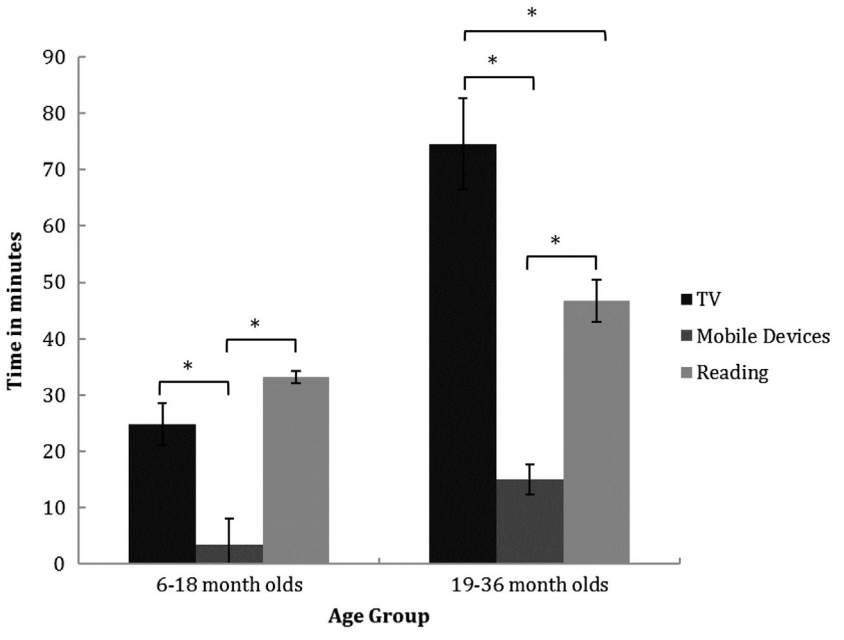

Figure 1. Mean time (+/− SE) spent engaged with television, mobile touchscreen devices and reading expressed in minutes for each age group

A two-way mixed ANOVA (age group: 6–18, 19–36 *X* type of media used: TV including DVDs, mobile touchscreen devices including tablets and smart phones, reading) was conducted to determine whether the type of media exposure differs across age. There was a significant main effect of age, $F(1, 127) = 49.66$, $p < .001$, $\eta_p^2 = .28$, demonstrating that 19–36 month olds ($m = 44.37$, SD = 2.32) spend more time engaging with media than 6–18 month olds ($m = 20.44$, SD = 2.48). Independent samples *t*-tests were conducted to compare media use for TV, mobile devices and storybooks by age. Effect sizes are reported using Cohen's *d*. Overall, the 19–36 month olds spent more time watching television, $t(98.52) = -5.70$, $p < .001$, $d = .97$, using mobile touchscreen devices, $t(88.63) = -4.13$, $p < .001$, $d = .23$, and reading, $t(128) = -2.38$, $p = .019$, $d = .02$, than the 6–18 month olds (see Figure 1). Mauchly's test indicated that the assumption of sphericity had been violated for the type of media used variable, $\chi^2(2) = 44.51$, $p < .001$. Therefore, the Greenhouse–Geisser corrected tests are reported ($\varepsilon = .771$) for the main effect of type of media and the interaction between type of media and age. There was a significant main effect of type of media used, $F(1.54, 195.75) = 34.00$, $p < .001$, $\eta_p^2 = .26$, with children watching more television ($m = 49.77$, SD = 51.77, $p < .001$) and reading ($m = 40.31$, SD = 33.07, $p < .001$) than playing with mobile touchscreen devices ($m = 9.65$, SD = 18.00). Finally, there was a significant interaction between exposure to TV, mobile touchscreen devices and reading and the age of the child, $F(1.54, 195.75) = 10.54$, $p < .001$, $\eta_p^2 = .08$. As shown in Figure 1, children aged 6–18 months spent more time watching television ($p < .001$) and reading ($p < .001$) than they did using mobile touchscreen devices. In contrast, 19–36-month-old children spent more time watching television than using mobile touchscreen devices ($p < .001$) and reading ($p = .012$), and spent more time reading than using mobile touchscreen devices ($p < .001$).

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Table 2. Correlation between time spent exposed to other activities and exposure to reading, television and mobile touchscreen devices expressed by age group.

	Correlation coefficients					
	6–18 months old			19–36 months old		
	n = 59			*n* = 71		
	Other activities	Reading	TV	Other activities	Reading	TV
Reading	−.275*			.247*		
TV	−.111	−.065		−.008	−.104	
Mobile devices	.009	.027	.237	−.157	.005	.090

*Correlation is significant at the .05 level.

Table 3. Hierarchical regression model for children's screen media exposure (*n* = 131).

	B	SE *B*	*β*	*p*
Step 1				
Constant	28.01	16.99		.102
Age	3.41	.61	.44*	<.001
Gender	−21.76	10.08	−.17*	.033
Educational attainment	−30.06	13.02	.18*	.023
Step 2				
Constant	−24.83	33.50		.460
Age	3.22	.60	.41*	<.001
Gender	−22.38	9.87	−.17*	.025
Educational attainment	−25.00	13.36	.15	.064
Media availability	13.25	4.96	.21*	.009
Other activities	−.12	.12	−.08	.348

Notes: $R^2 = .233$ for Step 1: $\Delta R^2 = .044$ for Step 2: $p = .025$.
*$p \leq .05$.

Despite the arguably large amount of time children spent engaging with screen media defined as TV and mobile devices, this time did not offset the amount of time that children spent reading or doing other non-media-related activities at 6–18 months or at 19–36 months (see Table 2). Correlation analyses showed no significant relationships between screen media and storybook reading or other activities. For the 6–18-month-old infants, there was, however, a significant negative correlation between doing other activities and reading. The more time children spent doing other activities the less time they spent reading and vice versa. In contrast, for the 19–36-month-old infants, there was a significant positive correlation between other activities and reading, meaning that the more time children spent exposed to other activities the more time they also spent reading.

Predictors of screen media exposure

A hierarchical regression analysis was conducted to determine predictors of children's screen media exposure (TV and mobile device time). For all regression analyses, gender was coded as 1 for males and 0 for females. Educational attainment was coded on a scale of 1 for University degree or higher and 0 for below graduate level education. Media availability was calculated as a score out of 7 depending on the number of devices available in the child's home. Overall, age, gender, and media availability explained 28% of the variance in children's media exposure (see Table 3). More media available in the home, older children and female children were associated with more time spent exposed to screen media.

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Language development

For 90 of the 97 respondents that also completed the language questionnaire, English was the only language spoken at home. Three respondents spoke English and one other language at home and four respondents exclusively spoke another language at home; these seven respondents were excluded from the subsequent analyses. For the UK-CDI and Lincoln UK-CDI questionnaires, children were given total scores for the number of words that the child comprehends and the number of words that the child produces (see Table 4). These scores were calculated by summing the number of items that the parent had marked as "understands" or "understands and says" for the comprehension score and the number of items that the parent had marked as "understands and says" for the production score. Percentages were also calculated as the total number of words that the child comprehends or produces as a percentage of the total number of words on each CDI (UK-CDI 392, Lincoln UK-CDI 663).

To determine the predictors of children's language development, two hierarchical regression models were run with children's CDI comprehension and production scores for the 6–18-month-old infants (see Tables 5 and 6) and the 19–36-month-old infants (see Tables 7 and 8). These two groups were analyzed separately because norms for scores for the two versions of the CDI were not available, and so we were not able to determine the continuity between scores in the two groups. Overall, age predicted children's CDI comprehension and production scores at both age groups with older children having higher CDI comprehension and production scores. Time spent reading was a significant predictor of children's CDI scores at 6–18 months of age, explaining 7% of variance in comprehension and 25% of variance in

Table 4. Mean scores (SD) and percentages for language comprehension and production scores by children aged 6–18 months and 19–36 months.

		Mean Scores (SD)	
	n	CDI: Comprehension	CDI: Production
UK-CDI	51	104.9 (94.5)	19.1 (38.6)
6–18 months		26.8%	4.9%
LCDI	39	472.0 (168.6)	311.4 (246.7)
19–36 months		71.2%	47.0%

Table 5. Hierarchical regression model for children's CDI comprehension scores at 6–18 months of age ($n = 51$).

	B	SE *B*	*β*	*p*
Step 1				
Constant	−139.91	35.41		<.001
Age	20.89	2.66	.77*	<.001
Gender – Male	1.87	18.02	.01	.918
Educational attainment	−13.35	24.11	−.05	.582
Step 2				
Constant	−145.95	34.03		<.001
Age	19.76	2.65	.73*	<.001
Gender – Male	7.99	17.40	.04	.648
Educational attainment	−25.74	23.50	−.11	.279
Reading time	.69	.25	.26*	.008
TV time	.08	.32	.02	.814
Mobile device time	.93	1.60	.05	.564

Notes: $R^2 = .578$ for Step 1: $\Delta R^2 = .065$ for Step 2: $p = .059$.
*$p \leq .05$.

Table 6. Hierarchical regression model for children's CDI comprehension scores at 19–36 months of age ($n = 39$).

	B	SE *B*	*β*	*p*
Step 1				
Constant	−239.14	86.04		.009
Age	26.18	3.09	.80*	<.001
Gender – Male	−12.19	31.65	−.04	.702
Educational attainment	65.22	35.00	.17	.071
Step 2				
Constant	−280.49	105.77		.012
Age	28.27	3.54	.87*	<.001
Gender – Male	−27.96	33.93	−.08	.416
Educational attainment	70.03	35.68	.18	.058
Reading time	.31	.46	.07	.505
TV time	−.10	.29	−.03	.724
Mobile device time	−.87	.68	−.14	.210

Notes: $R^2 = .708$ for Step 1: $\Delta R^2 = .019$ for Step 2: $p = .538$.
*$p \leq .05$.

Table 7. Hierarchical regression model for children's CDI production scores at 6–18 months of age ($n = 51$).

	B	SE *B*	*β*	*p*
Step 1				
Constant	−41.20	19.31		.038
Age	5.45	1.45	.49*	<.001
Gender – Male	−10.82	9.83	−.14	.277
Educational attainment	−1.59	13.15	−.02	.904
Step 2				
Constant	−44.83	16.55		.010
Age	5.24	1.29	.47*	<.001
Gender – Male	−7.81	8.46	−.10	
Educational attainment	−12.24	11.43	−.12	.361
Reading time	.52	.12	.49*	.290
TV time	−.10	.16	−.07	<.001
Mobile device time	−.72	.78	−.10	.543

Notes: $R^2 = .246$ for Step 1: $\Delta R^2 = .247$ for Step 2: $p = .001$.
*$p \leq .05$.

Table 8. Hierarchical regression model for children's CDI production scores at 19–36 months of age ($n = 39$).

	B	SE *B*	*β*	*p*
Step 1				
Constant	−681.64	126.28		<.001
Age	38.23	4.53	.79*	<.001
Gender – Male	−48.01	46.44	−.10	.308
Educational attainment	52.06	51.36	.09	.318
Step 2				
Constant	−716.03	159.42		<.000
Age	39.81	5.33	.83*	<.001
Gender – Male	−55.99	51.13	−.11	.282
Educational attainment	55.76	53.77	−.10	.308
Reading time	.11	.69	.02	.873
TV time	.02	.43	.00	.966
Mobile device time	−.66	1.02	−.07	.520

Notes: $R^2 = .706$ for Step 1: $\Delta R^2 = .004$ for Step 2: $p = .932$.
*$p \leq .05$.

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production scores over and above variance explained by age. Time spent reading did not significantly predict children's CDI comprehension or production scores at 19–36 months of age. Exposure to screen media such as TV, DVDs, and mobile touchscreen devices did not predict CDI comprehension and production scores for either age group.

Discussion

Screen media exposure

In the first world, children now live in a digital age. Our results indicate that among our sample of highly educated families in the UK, a high proportion of children aged 6–36 months watch television (82%) and use mobile touchscreen devices (49%). Moreover, children's screen media use increases strikingly with age. In the present sample, 19–36-month-old children spent more time engaging with screen media than the 6–18 month olds, consistent with prior patterns of findings (Rideout, 2013). Overall, it is perhaps not surprising that fewer children use mobile touchscreen devices compared with television in the present study due either to the appropriateness of the content or difficulty operating mobile touchscreen devices (but see Aziz, Syuhada, Batmaz, Stone, & Wai, 2014). Although a large number of children watched television in the present study, a greater number of children were read to daily. Around 99% of children were read to daily. This may be due to the fact that the goal of storybook reading is often to promote parent–child bonding (Audet, Evans, Williamson, & Reynolds, 2008) and in a nationally representative sample of American parents, 96% believed that reading has an educational benefit (Rideout et al., 2003).

The majority of parents in the present study reported that their children typically watch children's programs when watching television. This finding is inconsistent with prior work by Barr and colleagues who found that younger children were exposed to a higher proportion of adult-directed television programs than older children (Barr et al., 2010). However, Barr et al. (2010) used a diary method to measure household television usage and 6–18-month-old children's television exposure. Although we did measure children's exposure to background television in the present study, it is possible that parents did not include the content of background television when they reported the television programs that children are typically exposed to.

There was no effect of screen media use in reducing the time children spent engaging with other activities or reading. This finding is consistent with Vandewater et al. (2006) who used a diary method in 1997 to study whether television exposure interferes with other developmentally appropriate activities at 0–12 years of age. However, our finding also contrasts with prior work in with low SES families and families with heavy television use (Tomopoulos et al., 2010; Vandewater et al., 2005) who found that greater television use was associated with less time spent reading. Heavy television use was defined by Vandewater et al. (2005) as households where the television was on all or most of the time, according to this definition, just 21% of our sample could be classed as heavy television users. Indeed, prior work has reported lower levels of background television in high SES families compared to low SES families (Lapierre, Piotrowski, & Linebarger, 2012). It is therefore possible that the limited variability of television use in our sample precluded any effect of heavy television use on other activities.

There was a negative correlation between time spent reading and engaging with other activities for 6–18 month olds and a positive correlation between time spent reading and

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engaging with other activities for 19–36 month olds. The negative correlation between reading and other activities for the 6–18 month olds may reflect the developmental changes in children's ability to engage with these other activities such as playing, baking, and crafts. Thus, parents may potentially read more to the youngest infants who are limited in the number of activities they can engage with and less to older children who are more independent and varied in their skills. Thus, 19–36 month olds are able to engage in numerous activities and as a result, parents who also read to their children may also be more likely to engage them with other activities. Approximately 28% of variability on time spent engaging with screen media was explained by age, media availability, and gender, with older and female children spending more time engaging with screen media. Thus, there remains a considerable amount of variability in screen media exposure that is as yet unexplained.

Language and screen media exposure

There are numerous established predictors of child language development. In their seminal study, Fenson et al. (1994) documented a large positive effect of age on CDI scores and a very small effect of gender with girls scoring more than boys. Consistent with Fenson et al., age predicted language comprehension and production scores with gender also predicting language production in the present study. We found no association between parent education and CDI scores (also see Westerlund & Lagerberg, 2008), which is likely due to the fact that the majority of our sample were highly educated consistent with our sampling method.

In the current sample, storybook reading predicted children's comprehension and production scores at 6–18 months of age. Though we cannot be sure of the causal relationship between reading and language scores, these findings are consistent with previous work that has demonstrated a reliable relationship between storybook reading and language development across development (Elley, 1989; Farrant & Zubrick, 2012; Ninio, 1983; Raikes et al., 2006; Robb et al., 2009; Scarborough & Dobrich, 1994; Sénéchal & LeFevre, 2002; Sénéchal et al., 1996; Zimmerman et al., 2007). Storybook reading explained a greater proportion of variance in the 6–18-month-old production scores compared to their comprehension scores. Storybook reading can be particularly useful for supporting vocabulary production through the use of didactic questioning (Sénéchal, 1997). It is possible therefore, the greater variance explained by storybook reading on production scores compared to comprehension scores reflects parents greater use of didactic questioning techniques in our sample. For the 19–36 month olds, storybook reading was not significantly related to comprehension and production scores. Prior work has demonstrated that vocabulary scores at 34 months of age are predicted by the number of minutes children were read to between 9 and 34 months of age (e.g., Farrant & Zubrick, 2012). Thus, our single time point measure of reading was likely unable to precisely capture the relationship between reading and language development for the older age group. It is also important to note here that comprehension scores at 19–36 months of age are not included in the original McArthur Bates CDI: Toddler given that comprehension scores are likely to be less reliable than production scores at these ages (Fenson et al., 1994).

With respect to screen media and language development, our findings support prior work and add to the converging evidence for no direct relationship between general television viewing and language development (Richert et al., 2010; Robb et al., 2009). However, it is important to note that we did not consider individual television program categories

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(e.g., educational vs. entertainment) which have shown both positive and negative effects, respectively, on language development in prior work (Ferguson & Donnellan, 2014; Vandewater, 2011; Zimmerman et al., 2007). Moreover, our use of a cross-sectional design also prevents us inferring the direction of effect or role of longitudinal storybook reading or screen media use on language development but rather provides a snapshot of children's language development and concurrent media use.

Mobile device use was also not associated with language development. This novel finding likely reflects the fact that although 49% of children under 3 years used mobile touchscreen devices daily, children on average spent less than 20 min a day using mobile devices. This amount of exposure was likely insufficient to impact on language development. Given that the majority of children in the present study were using apps, future work should start to consider the role of educational apps on children's language development (see Kirkorian, Choi, & Pempek, 2016, for recent work on this issue). This early exposure provides challenges, but also a wealth of opportunities, for interventions in language learning research.

Importantly, the lack of relationship found between screen media exposure and vocabulary size in our study may apply to the highly educated parent samples in our group. Indeed, CDI comprehension and production scores in our sample were high compared to those reported by Fenson et al. (1994). Nevertheless, there was sufficient variance within our sample of parents to reflect differences in language development associated with time spent reading. Thus, if screen media use had a similar sized effect on language development as reading then we would expect to observe a significant effect of media use. We can therefore be confident that the size of the influence of television and mobile touchscreen device use on language development, if it does exist, is substantially smaller than that of reading in a highly educated sample.

The association between screen media exposure and language development in lower SES samples remains to be determined and represents an important avenue for future work. The association between SES and children's language development is well documented (Hart & Risly, 1995; Huttenlocher et al., 2010; Weisleder & Fernald, 2013). Research demonstrates that parents of low SES families say fewer words to their children, use fewer communicative gestures with their children, and allow their children to spend more time with screen media (Hart & Risly, 1995; Rideout, 2011; Rowe & Goldin-Meadow, 2009). Furthermore, in a low SES sample, language development at 14 months was negatively associated with media exposure at 6 months of age (Tomopoulos et al., 2010). Whether increased media exposure reduces the number of words that children hear in low SES families, and thus mediates the relationship between screen media exposure and language acquisition, remains to be determined. Importantly, prior work has found that parental verbal interactions with their children about television content can mediate the adverse impact of screen media on language development (Mendelsohn et al., 2010). Therefore, future work should focus on the role of parent–child co-use during storybook reading, television and mobile device use on language development between high and low SES families.

Conclusions

In conclusion, our data suggest that screen media exposure in children under 3 years of age is high, though seemingly not at the expense of other potentially more educationally beneficial activities. Vocabulary size was not predicted by television and mobile touchscreen

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device use in this sample. Thus, there is no evidence from our study that television and mobile touchscreen device use has a positive, or a detrimental, effect on language learning in highly educated samples with moderate media use. In contrast, reading with children was positively related to vocabulary size. Thus, as long as time spent reading is not reduced in place of television and mobile touchscreen activities, children's media exposure should not adversely affect their vocabulary size. Prior work has shown that SES influences the quantity and variety of parent speech with their children which influences subsequent child language development (Hart & Risly, 1995; Huttenlocher et al., 2010; Weisleder & Fernald, 2013). Thus, accessing a lower SES sample will be essential for further investigating the range and consequences of the relationship between screen media exposure, storybook reading and children's language development in the population more broadly.

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